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(12) **Patent:** (11) **CA 910271**

(54) PLURAL STAGE CENTRIFUGING WATER RECYCLE

(54)

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ABSTRACT:

CLAIMS: Show all claims

*** Note: Data on abstracts and claims is shown in the official language in which it was submitted.

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This invention relates to an improvement to plural stage centrifuging of bitumen from the froth produced in a hot water process for separating bitumen from bituminous tar sands. Tar sands are primarily composed of a fine quartz sand having a particle size greater than that passing 325 mesh screen. The quartz sand is impregnated with a viscous bitumen in quantities of from 5 to 21 weight percent of the total composition. More typically the bitumen content is from 8 to 15 percent. This bitumen is quite viscous and contains typically 4.5 percent sulfur and 38 percent aromatics. Its specific gravity at 60°F. ranges typically from about 1.00 to about 1.06. In addition to the bitumen and quartz sand, the tar sands contain clay and silt in quantities of from 1 to 50 weight percent of the total composition. Silt is normally defined as material which will pass a 325 mesh screen but which is larger than 2 microns. Clay is material smaller than 2 microns including some siliceous material of that size.

In the hot water process for separating bitumen from tar sands, the sands are jetted with steam and mulled with a minor amount of hot water at temperatures in the range of 140° to 210°F. The resulting pulp is dropped into a stream of circulating hot water and carried to a separation cell maintained at a temperature of about 150° to 200°F. In the separation cell, sand settles to the bottom as tailings and bitumen rises to the top in the form of an oil froth. An aqueous middlings layer containing some mineral and bitumen is formed between these layers. A scavenger step may be conducted on the middlings layer from the primary separation step to recover additional amounts of bitumen therefrom. This step usually comprises aerating the middlings as taught by K. A. Clark, "The Hot Water Washing

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Method," Canadian Oil and Gas Industries 3, 46 (1950). These froths are then combined, diluted with naphtha and centrifuged to remove more water and residual mineral. The naphtha is then distilled off and the bitumen is coked to a high quality crude suitable for further processing. The hot water process is described in detail in Floyd et al., Canadian Patent 841,581 issued May 12, 1970.

The bitumen product from this hot water process has a very specific composition. The product contains 35 to 45 weight percent water and 5 to 10 weight percent mineral before dilution. The water content of this product must be reduced to 4 to 6 weight percent and the mineral to 1 to 2 weight percent before the product can be further processed. This reduction can be accomplished by plural stage centrifuging as described in Evans et al., Canadian Application Serial No. 052,223, filed May 22, 1969, or as in Coulson, Canadian Patent 596,561. Each stage of the centrifuging operation can consist of a single machine or each stage can comprise a battery of units connected in parallel. In these operations the first stages are conducted by the application of relatively low forces to remove larger mineral while relatively higher forces are applied in the later stages to remove the smaller mineral and most of the water. The mineral and water discharged from the centrifuges must be removed from the centrifuging zone for disposal. Unfortunately, the mineral removed in the first stages of the operation is relatively larger material which has little flowability and cannot be piped to a disposal area in its discharged form. On the other hand, the mineral discharged from the later stages is finely-divided and suspended in discharge water and presents no handling problem. It has been found by the present invention that the mineral from the

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first stages of centrifuging can be made flowable and at the same time an integrated centrifuging operation for upgrading bitumen can be provided by adding the water separated in the later stages of centrifuging to the mineral separated in the earlier stages to make the larger mineral flowable and suitable for removal to a disposal zone. It has also been found that flowability is achieved if the larger mineral water mixture contains at least about 50 weight percent water.

Thus, this invention is a process for treating bitumen from hot water process froth which bitumen contains water and mineral, the process comprising; centrifuging the bitumen in a plurality of centrifuge separation zones to produce water, mineral, and a bitumen product reduced in water and mineral content in each zone, and adding water separated in a later centrifugal separation zone to mineral separated in an earlier centrifugal separation zone to increase the flowability of said mineral.

The process is also an improvement to the hot water process for treating bituminous tar sands wherein the process comprises: forming a mixture of tar sands and water; passing the mixture to a separation zone to form a bitumen froth layer containing some water and mineral, a water middlings layer, and a sand tailings layer; removing the bitumen froth layer from the separation zone; and centrifuging the bitumen in the bitumen froth layer in a plurality of centrifugal separation zones to produce water, mineral and a bitumen product reduced in water and mineral content in each zone. The improvement comprises: adding water separated in a later centrifugal separation zone to mineral separated in an earlier zone to increase the flowability of the mineral. It might be thought that any

water stream could be added to the mineral to make a flowable mixture. However, the adding to water which is produced in a later centrifugal separation zone results in an integrated centrifuging operation which not only advantageously produces a flowable discharge of mineral but also conserves fresh water.

The disposal of any of the water discharged from a hot water process and its auxillary operations poses a problem. This water must eventually be stored, disposed of, or recycled back into some part of the process. Because this water, including that from the centrifuging operations, contains bitumen emulsions, finely dispersed clay with poor settling characteristics, and other contaminants, water pollution considerations prohibit discarding it into rivers, lakes or other natural bodies of water. It has been proposed that the water be stored in evaporation ponds but this proposal would involve large space requirements and the construction of expensive enclosure dikes. It has also been suggested that the water from the process and its auxillary operations be recycled back into the process as an economic measure to conserve both heat and water. Floyd et al. teach that some of this water can be so recycled but that the amount of recycle is limited by dispersed silt and clay content which can reduce froth yield by increasing the viscosity of the middlings layer and retarding the upward settling of bitumen flecks. A proportion of water in the diluted tar sands pulp fed into the separation cell must therefore be fresh water--water which is substantially free of the clay and silt found in middlings water. In fact, with some clay content tar sand feeds, all of the water in the diluted pulp must be added as fresh water.

The present invention avoids some of these problems of water utilization by utilizing water produced in a later centrifugal separation zone to increase the flowability of mineral instead of utilizing a stream of fresh water. Thus, by means of the present invention, an integrated process is provided which produces a substantial benefit in the plural stage centrifuging of bitumen from bituminous tar sands froth produced in a hot water process.

The Figure is a schematic representation of the present invention. The drawing illustrates the invention as applied to a two-stage centrifuging of bitumen from tar sands froth employing a single unit for each stage, however, the present invention is applicable to any plural stage operation using two or more stages and is also applicable to an operation which uses a plurality of units in one or more stages.

In the figure the bitumen 1 from tar sands froth is diluted with diluent 2 to reduce its density to less than 1 g. per ml. and is fed into a first centrifuging zone 3 which can be a battery of one or more centrifuges. In this zone the larger sand material is removed 4 from the bitumen along with some water and the bitumen is passed on 5 to the second centrifuging zone 6. Although the sand discharged from the first zone 3 via line 4 contains some moisture, it does not contain enough water to be flowable for removal. Therefore, a stream of water derived as hereinafter described is added from 7 to the removed mineral 4.

Water is added to the second stage centrifuge zone 6 via line 8. In this zone 6, which can comprise one or more centrifuges, the bitumen is centrifuged to a final product 9

which contains substantially less mineral and water than the feed bitumen 1. Water is removed from centrifuging zone 6, via line 10 and in part is recycled 8 to zone 6. The water from line 10 is designated "ring-dam" water, and its function is described in Thompson et al., Canadian Patent Application Serial No. 055,750, filed June 30, 1969. Water is also removed from zone 6 via line 7 and is used to dilute sand 4 from the first zone 3 to make this sand flowable as per the present invention.

The following example illustrates the present invention:

A bitumen froth 1 from a hot water process for treating tar sands comprising about 50 percent bitumen, 40 percent water and 10 percent mineral matter, is heated with steam to about 160° to 180°F. and diluted 2 with naphtha at a ratio of 0.5 diluent to bitumen. The diluted and heated bitumen is then passed to a first stage centrifuging zone 3 which comprises 8 scroll-type machines arranged in parallel. About 50 percent of the mineral contained in the bitumen is separated and discharged from this first zone. This mineral contains some moisture but not enough to make it flowable. The bitumen product from the first zone 3 is mixed with ring-dam recycle water and is fed into a second centrifuging zone 6 which consists of disc-type units. The second zone produces a bitumen product containing about 4 percent water and 1.0 percent mineral some of which is greater than 10 microns in diameter. Water discharged from the nozzles of this second stage 6 is used to be added to the mineral from the first stage to produce a flowable mixture which is removed from the centrifuging zones and discharged into a tailings pond.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A process for treating bitumen froth recovered from a hot water process for extracting bitumen from tar sands, said bitumen containing water, coarse minerals and fine minerals, comprising:

(a) centrifuging said bitumen froth in a first centrifuge stage to divide said froth into a coarse mineral matter stream and bitumen, water and clay stream;

(b) combining said bitumen, water and clay stream with a first recycle water stream recovered from hereinafter defined second stage centrifuging step;

(c) centrifuging the bitumen, water, clay and recycle stream mix in a second stage centrifuging step to produce (1) a bitumen product substantially free of water and mineral matter, (2) a first recycle water stream and (3) a second recycle water stream;

(d) combining a part of the first recycle water stream with the bitumen, water, clay stream of step (b) and discarding the remainder of the first recycle stream and

(e) combining said second recycle water stream with the coarse mineral matter stream of step (a) to provide a more flowable stream and thereafter discarding the combined streams.

2. The process of Claim 1 in which said bitumen is heated to temperatures within the range of 160° to 180°F.; diluted with a hydrocarbon diluent to reduce the bitumen density to less than 1 g. per ml.; and thereafter centrifuged in said series of at least two centrifuging separation zones.

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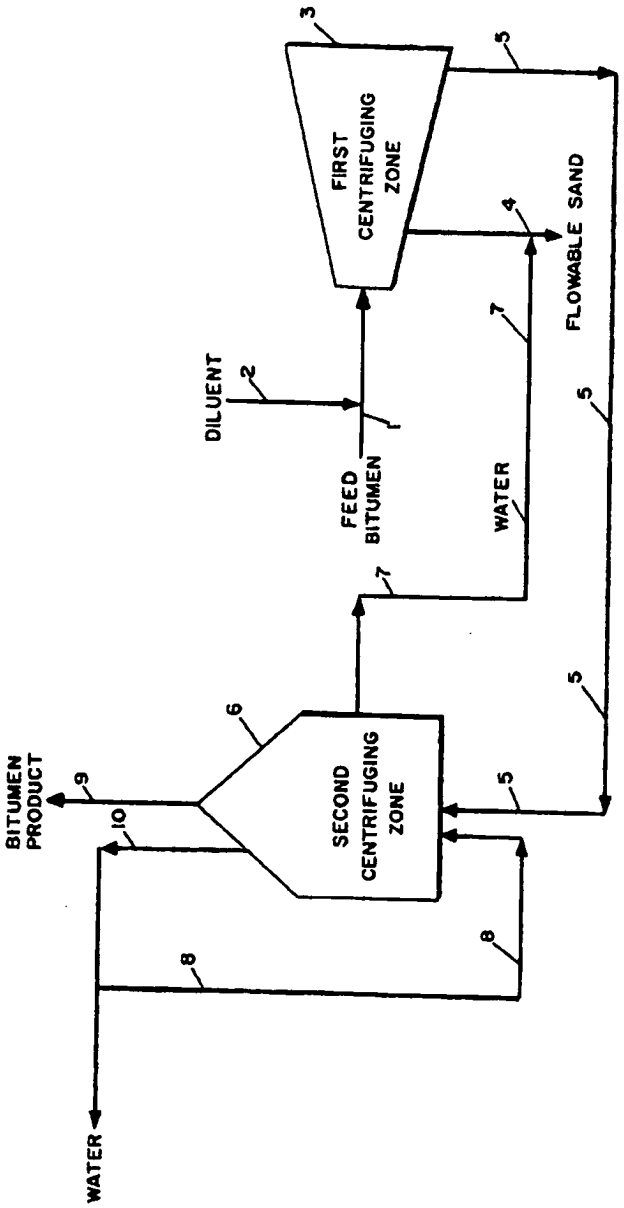

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